2 ← Power
3 ← base

Name: _____ **Date:** _____

Math 10F&PC Chapter 4 Roots and Powers

4.6 Applying the Exponent Laws

Focus: *The exponent laws apply to powers with rational and variable bases, and to powers with rational exponents.*

Exponent Law		***Numerical Example***
Product of powers	$a^m \cdot a^n = a^{m+n}$	$3^4 \times 3^3 = 3^{4+3} = 3^7$
Quotient of powers	$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$	$3^4 \div 3^3 = 3^{4-3} = 3^1$
Power of powers	$(a^m)^n = a^{mn}$	$(3^4)^3 = 3^{4\times3} = 3^{12}$
Power of products	$(ab)^m = a^m \cdot b^m$	$(3x)^3 = 3^3 \cdot x^3 = 27x^3$
Power of quotients	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$	$\left(\frac{3}{7}\right)^4 = \frac{3^4}{7^4}$

Add the 2 Rules that we learned this unit...

Rule #1: Powers with Rational Exponents: $x^{\frac{m}{n}} = \sqrt[n]{x^m}$ Ex. $32^{\frac{2}{5}} = \left(\sqrt[5]{32}\right)^2$

Rule #2: Powers with Negative Exponents: $x^{-n} = \frac{1}{x^n}$ $3^{-2} = \frac{1}{3^2} = \boxed{\frac{1}{9}}$

Example 1: *Simplifying Numerical Expressions with Rational Bases*

1. $0.3^{-3} \cdot 0.3^5$

$0.3^{-3+5} = \boxed{0.3^2}$

$= 0.09$

2. $\frac{(1.4^3)(1.4^4)}{1.4^{-2}}$

$= \frac{1.4^{3+4}}{1.4^{-2}} = \frac{1.4^7}{1.4^{-2}} = (1.4)^{7-(-2)}$

$= \boxed{1.4^9}$

3. $\left[\left(-\frac{3}{2}\right)^{-4}\right]^2 \cdot \left[\left(-\frac{3}{2}\right)^2\right]^3$

$\left(-\frac{3}{2}\right)^{-8} \cdot \left(-\frac{3}{2}\right)^6$

$\left(-\frac{3}{2}\right)^{-8+6} = \left(-\frac{3}{2}\right)^{-2} = \left(-\frac{2}{3}\right)^2$

4. $\left(\frac{7^{\frac{2}{3}}}{7^{\frac{1}{3}} \cdot 7^{\frac{5}{3}}}\right)^6$

$\left(\frac{7^{\frac{2}{3}}}{7^{\frac{1}{3}} \cdot 7^{5/3}}\right)^6 = \left(\frac{7^{\frac{2}{3}}}{7^{\frac{6}{3}}}\right)^6$

$\frac{7^{\frac{2}{3}\times6}}{7^{\frac{6}{3}\times6}} = \frac{7^4}{7^{12}} = 7^{4-12} = 7^{-8}$

$= \boxed{\frac{1}{7^8}}$

Example 2:

1. $(x^3y^2)(x^2y^{-4})$

$x^{3+2} \cdot y^{2-4}$

$x^5 \cdot y^{-2} = \boxed{\frac{x^5}{y^2}}$

2. $\frac{10a^5b^3}{2a^2b^{-2}}$

$= 5a^{5-2} \cdot b^{3-(-2)}$

$= \boxed{5a^3 \cdot b^5}$

3. $m^4n^{-2} \cdot m^2n^3$

$m^{4+2} \cdot n^{-2+3}$

$\boxed{m^6 \cdot n^1}$

4. $\frac{6x^4y^{-3}}{14xy^2}$

$= \frac{3}{7} x^{4-1} \cdot y^{-3-2}$

$= \boxed{\frac{3x^3}{7y^5}}$

Example 3: *Simplifying Algebraic Expressions with Rational Exponents*

1. $(8a^3b^6)^{1/3}$

$8^{\frac{1}{3}} \cdot a^{3 \times \frac{1}{3}} \cdot b^{6 \times \frac{1}{3}}$

$\boxed{2a \cdot b^2}$

2. $(x^{3/2}y^2)(x^{1/2}y^{-1})$

$x^{\frac{3}{2}+\frac{1}{2}} \cdot y^{2-1} = \boxed{x^2 \cdot y}$

3. $\frac{4a^{-2}b^{2/3}}{2a^2b^{1/3}}$

$= 2a^{-2-2} \cdot b^{\frac{2}{3}-\frac{1}{3}}$

$= \boxed{2a^{-4}b^{\frac{1}{3}}}$

4. $\left(\frac{100a}{25a^5b^{-1/2}}\right)^{1/2} = \frac{100^{\frac{1}{2}} a^{\frac{1}{2}}}{25 \; a^5 \; b^{-\frac{1}{2}}}$

$= \frac{10 \; a^{\frac{1}{2}}}{25 \; a^5 b^{-\frac{1}{2}}} = \frac{2}{5} a^{\frac{1}{2}-5} \cdot b^{\frac{1}{2}}$

$= \frac{2}{5} a^{-\frac{9}{2}} b^{\frac{1}{2}}$

Solving Problems Using the Exponent Laws

A sphere has volume 425 m^3. What is the radius of the sphere to the nearest tenth of a metre?

Use the formula $V = \frac{4}{3} \pi r^3$.

Quiz 4.3 - 4.5 next day

Assignment: *p. 241-242 #s 12, 15-17, 19, #s 21, 22* ***– Challenge Questions: If you can get these items right showing all steps then you are ready for 4.4-4.6 Quiz next day***